

CSC REPORT



OPERATIONS RESEARCH AND THE STOCK MARKET

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Reviewing the printout of a convertible bond analysis are (l - r) Dr. Donald Stewart, Dr. Allan Harbaugh, and Patrick Meehan.

Despite the vast quantities of data handled daily on the stock exchange, application of electronic data processing has been far slower than in comparable fields. However, reporting procedures and several bookkeeping functions are gradually succumbing to the economies inherent in edp. Initial studies in the movement of stocks have also prompted several leading brokerage firms to explore the use of computers and allied techniques for projections and analyses.

At CSC, several members of the Operations Research staff are currently engaged in computer-aided analysis of various investment situations in the national stock and bond markets. Dr. Allan W. Harbaugh, Dr. Donald I. Stewart and Patrick Meehan have developed and programed methods for determining the expected value of stock market options (puts and calls), warrants, and convertible bonds and hedges on the 1107.

Their analyses are based on the observed statistics of stock price movements on national exchanges, and provide previously unavailable results which can be used by security analysts and investors as tools in reaching investment decisions.

Dr. Harbaugh made an original study of puts and calls two years ago when he was associated with the Engineering Executive Program at UCLA. (A "put" is an option to sell 100 shares of stock at a stated price (the option price) per share within a prescribed period of time. A "call" is a similar option to buy 100 shares of stock). He programed his work on the university's G-15 computer and prepared charts which enable an investor to rapidly evaluate any option offering, including strips, straps,

spreads, and straddles, which consist of various combinations of puts and calls. A limited amount of data on the experience of the public with calls, later published by the Securities and Exchange Commission, has confirmed the accuracy of his analysis.

At CSC, Dr. Harbaugh adapted the analysis to the evaluation of warrants (options to purchase stock at stipulated times and prices). Mr. Meehan wrote a 45-statement FORTRAN program for the warrant analysis which was run on CSC's 1107. The result is a "handbook" of tables with which an investor can quickly evaluate any warrant in which he is interested.

The analysis can also be programed to provide a periodically updated (e.g., weekly) listing for all warrants as a service to investors. This can include the effects of warrant terms which change with time.

Within recent months, Drs. Harbaugh and Stewart have collaborated in producing an analysis of the expected value of convertible bonds and hedges. (A convertible bond is one which can be exchanged for shares of stock at the option of the holder. A hedge consists of the purchase of a convertible bond and the simultaneous short sale of the associated stock). This analysis is somewhat more complicated than the warrant and option analyses. Among the factors considered are bond interest, bond and stock prices, the terms of the conversion privilege, their changes with time, and the bond maturity date. The analysis shows whether a bond is in a hedge range, and provides information on the expected and minimum equivalent interest rates for various holding times, as well as present discounted minimum and

expected values for various levels of hedging. This enables the investor to evaluate each bond according to his own investment objectives.

Mr. Meehan has prepared a 95-statement FORTRAN program which computes and prints out this information for any number of bonds desired. Once the information on conversion privileges, maturity, coupon rate, etc., has been stored, the listing can be updated periodically by reading in the current date, and current values of stock and bond prices from the exchanges.

The usefulness of these analyses may be illustrated by the following example: Suppose that convertible bonds are being considered as an investment opportunity. Such bonds normally pay interest and have a high degree of safety, as well as the possibility of greater gain if the stock rises sufficiently.

The analyst can call for a computer printout of current results of the mathematical analysis for each of the many convertible bond issues available.

For each convertible bond, results will show:

- (a) Present discounted expected value.
- (b) Present discounted minimum value (i. e., assuming that conversion is never profitable).
- (c) Expected effective interest rate for various holding times.

- (d) Minimum effective interest rate for various holding times.
- (e) Whether or not the bond is in a hedge range (i. e., whether a short sale of the stock can increase the minimum value).
- (f) If in a hedge range, the increase in minimum value achievable and the consequent decrease of expected value reached by selling short various amounts of stocks.

By considering the particular investment objectives sought, and in the light of his esoteric knowledge of stocks, bonds, and market conditions, the analyst can use the mathematical results as guides to reaching appropriate investment decisions.

Furthermore, after investments in bonds have been made, computer analyses can be called for periodically to evaluate their current expected and minimum values, expected interest rate, etc. In this manner the value of an investment (or a complete portfolio) can be compared with alternate opportunities as time progresses.

CSC personnel are presently collaborating with brokers and security analysts in designing the mathematical analyses for specific applications. A technical report on this subject is available by contacting Dr. Harbaugh.

CSC TO HOST USE

A UNIVAC 1107 Users meeting set for July 10-11 will be hosted by CSC. Attendees will be housed at the Airport Marina Hotel during the two-day meeting.

A demonstration will be held at CSC of 1107 software during the first day of the conference. Hardware and software round-table discussions will follow on the afternoon of the first day and on the morning of the concluding day.

SERVICE BUREAU AIDS LONG BEACH HARBOR

In a recent contract with the Long Beach Harbor Department, CSC's 1107 computer will be helping to fill a J-shaped parcel of real estate extending over two miles into the Pacific Ocean from the present Long Beach shore line.

CSC's Service Bureau is also tackling a variety of management planning functions needed to complete the \$100-million addition to the present harbor facility. These include statistical evaluations of current operations at the harbor such as ship days per berth; dollar volume of various commodities; duration of ship stays; number of berths visited, and a daily census of ships in port.

Much of this data will be compiled in a projection of new berths and Harbor Department recommendations for greater efficiency of present facilities. Finally, statistical analysis of these reports will be used in the transitional planning and control of ship traffic from present to new facilities.

Shipping trade at the Long Beach seaport has increased almost 100% in the past ten years. By 1970, there will be 81 municipal deep water cargo berths completed or under construction with a total of 90 projected for 1985. At present, there are 48 such berths in operation and six operating private facilities. It is ranked as the world's largest man-made harbor.

In announcing the appointment of CSC for this extensive development project, Service Bureau Manager Daniel R. Mason noted that the present site of Pier J, projected as the largest of

the harbor's 12 piers, lies 47 feet beneath the surface of the Pacific. In the construction of this pier, about 320 acres of ocean will be displaced by 3,000,000 tons of rock and 33,000,000 cubic yards of earth fill.

CSC will also utilize a digital plotter system to provide a graphic representation of the construction process. Equipment to be used for this purpose is the General Dynamics SC 4020, a \$200,000 accompaniment to the 1107.

The Long Beach contract includes computations for cut and fill, fill in place and triangulation network adjustment, as well as general statistical reporting and evaluation on port operations.

NEW YORK DIVISION DEVELOPS PAVE SYSTEM

A computer-oriented programming system for project planning known as *PAVE* (Programed Analysis for Value Engineering) is under development by CSC's New York Division.

As in PERT applications, the objective of *PAVE* is to provide a detailed control over the various activities involved in the planning of a project. In the *PAVE* system, however, there are no network or arrow diagrams. Activities are listed by logical categories with a set of controls to determine the basic project duration.

Major advantages of *PAVE* over PERT include an easily understood computer output of all information needed for preparing management reports; a more accurate estimate of project costs; a weekly presentation of resource requirements; a user determination of an optimum schedule based on restricted funding; a comparison of resource requirements to availabilities in order to optimize allocations, and a milestone chart which aids management in eliminating redundant efforts and ill-defined dependency among activities.

To prepare a *PAVE* program, project activities are listed and categorized by equipment, work classifications, functional re-

sponsibility, etc. Code numbers are then assigned to each activity and these are tabularized in chronological order. Prerequisite control activities are inserted wherever applicable and expected time estimates are assigned.

Should restricted funding, resource availabilities, and milestone chart restrictions be pertinent, project processing control cards are prepared. The user may also incorporate commentary information cards if he wishes to provide headings, footnotes, or any descriptive remarks concerning the project. A program processing control card is the final step in completing the input data which is ready for keypunching and processing.

Standard output from a computer run produces a milestone chart on which all activities are oriented to their earliest possible starting dates, and provides the user with a pictorial view of the entire project duration. The user also has the option of calling for an additional chart which shows each activity relative to its latest allowable starting time, and a combination of the two charts may be produced.

HOUSTON NETS TWO CONTRACTS

At Houston, two new contracts have been received from Brooks Air Force Base involving preparation of a data reduction program on work assignments for air force personnel, and updating officer enlistment records. Data processing on officer records will be accomplished at CSC's Service Bureau.

Managed by Harold Leone, the Houston Division plans to expand its technical staff to 25 in the near future.

A major feature article on this division was published this month in the Houston Post.

PERSONNEL INPUT

During the past two months, 51 man years of experience have been added to CSC's technical staff. Twelve new persons have joined the firm including eight technical staff members. These include Erwin Allen of Aerospace, Joan Cooney of Litton, Seymour Schwartz of Information Systems, Thomas Vickers of STL, Roger Fulton of Lawrence Radiation Labs, and Lewis Webb of Lockheed Missiles and Space, who will be working in the Scientific Applications Department; Howe Cun Fong of Bendix and Raymond Rogowski of Packard Bell have joined the Systems Programming Department and Gerald Kaminsky of Hughes is working in the Commercial Applications Group.

Since January '63, CSC has added over 22 new members to its technical staff with a total background of 103 man years in the computing profession.

OFFICE OF THE YEAR

The *Office of the Year Award* was presented to CSC last month by Administrative Management Magazine as one of ten outstanding new offices in 1962. Other firms selected include American Cyanamid, Bankers Trust Company of New York, Foster Wheeler Corporation, Humble Oil, Raytheon, American Baptist Convention, Earl Jordan Agency of the Massachusetts Mutual Life Insurance Company, Pure Oil Company and Union Tank Car Company.

A feature article in the publication described the highly functional aspects of CSC's new offices as well as their attractiveness of design.



Documentation Specialist Frank La Roche reviews cataloging procedures at CSC's Library.

LIBRARY RETRIEVAL

The CSC Library currently contains approximately 3,000 books, periodicals, and manuals dealing with computer applications and technology, programing, mathematics, and related areas. Items are catalogued on punched cards by subject, publisher, pertinent hardware and software, and other categories. The deck of punched cards, currently made up of over 7,000 unit records, is periodically fed into the Service Bureau's 1107, which has been programed to prepare retrieval listings by various categories. These listings are made available to all CSC divisions and departments, thereby facilitating use of the Library's holdings by all corporate and technical staff members.

HARDWARE PROSPECTUS

CSC has planned to install a General Dynamics SC 4020 digital plotter. This \$200,000 addition to the 1107 will be used by the Service Bureau. Bob Reinarts, Emily McCormick, and Bud Norrod are presently developing a 4020 software package for the 1107.

Eight high density drums were installed last weekend replacing the low density hardware. Storage capacity is 750 K words per drum.

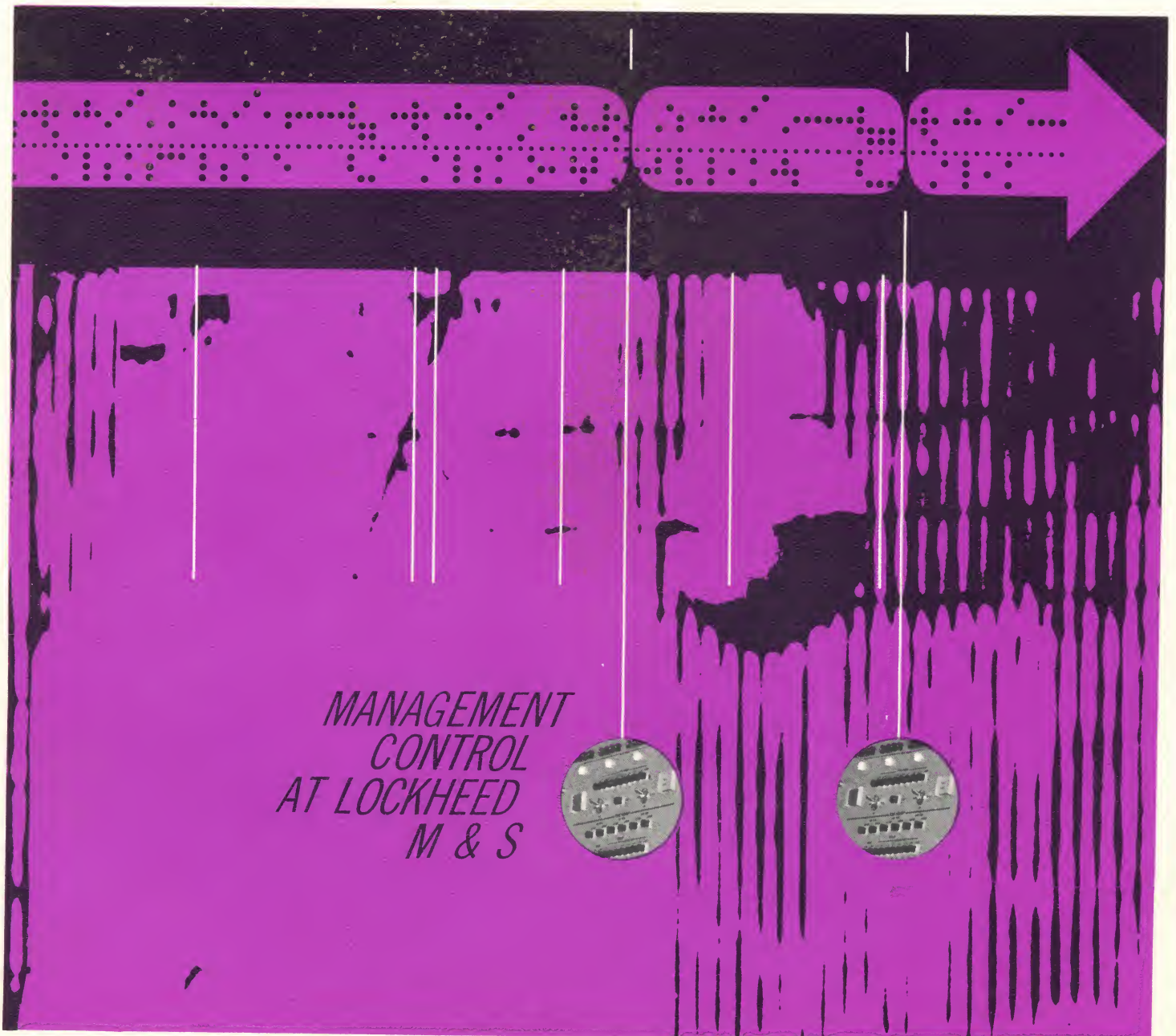
CSC's Service Bureau has also completed installation of IIIC (IBM compatible) tape drives operating at 62.5 KC, and a 300 CPM binary punch is also on the air.

In September, a UNIVAC 1004 card processor has been scheduled for delivery, and two 700-922 LPM printers will also be installed in the Fall.

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MANAGEMENT
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CSC has recently completed a 14-man-year participation in a "total system" approach for the Lockheed Missiles and Space Co. The Lockheed system is known as MCS/ADA (Management Control System/Automatic Data Acquisition), and represents one of the largest and most complex integrated management control systems ever developed.

Computers used for MCS/ADA are the RCA 301 with Bryant disks, IBM 7094, IBM 1410, and several IBM 1401's. The Lockheed system provides immediate production progress and inspection information plus backup management reports.

MCS/ADA combines real-time and batch processing. For example, location and work status entries are recorded on line as an assembly moves from one operation to the next. This information is available whenever the computer is interrogated from any inquiry station (input/output devices located appropriately throughout the facility). Periodically, the same information is consolidated for analysis and status reports.

Therefore, the integrated control system offers management a tool which provides immediate detailed information as required in addition to periodic summary analysis reports. Because the detailed information is available on demand, summary analyses often take the form of exception reports. Information in large volume and wide variety enters the system from many sources: e.g., catalogs, purchase orders, shop orders, and inspection reports. Correlation of this information in a rapid and meaningful manner is a prime task of MCS/ADA.

The data flow begins with an Engineering Parts List, which describes in detail all parts required for an assembly. Records from this list are edited and checked for validity against a master catalog file, after which inventory account code, procurement span time, and other data are added from control files. A "make or buy" decision is made and records are routed accordingly to Manufacturing or Procurement Programs. A feature of MCS/ADA called "Repetitive Requirements" permits additional requirements resulting from follow-on contracts to be entered into the system at this point. This obviates regeneration of Parts Lists

or Bills of Materials as requirements for additional assemblies develop.

Incoming requirements are received in the Inventory Status System where a determination is made as to whether the material is available in house. Should a purchase be necessary, the system summarizes requirements needed for a given part and produces a Purchase Order Request complete with part identification and specifications, price and bid history, and recommended vendor data. In addition, an open Purchase Request Record is maintained in the computer for purposes of auditing the purchase cycle. This document is utilized by the buyer who negotiates bids and returns to the computer program the information relative to selected vendor and pricing. The computer then prepares a formal Purchase Order and initiates the open Purchase Order Record. This record is updated by subsequent receipt activity and remains on the file until the order is satisfied. Subsequently, the closed Purchase Order file is utilized in various statistical studies. Some important features of the procurement program are:

1. Automatically generates "card" orders to vendors for approximately 20,000 parts covered by prearranged purchasing contract.
2. Assigns and monitors Purchase Request and Purchase Order numbers.
3. Accumulates various kinds of reference and statistical information as a by-product of the procurement action. These include price and bid information, vendor performance, work load backlog, etc.

Material requirements are reviewed in connection with the master schedule. By reference to this schedule, manufacture of each part may be initiated so that all parts for a given assembly may be completed at the appropriate time. A shop order (consisting of one or more Work Orders) is written and passed to a Shop Order Control program. Shop Order information enters the real-time system at this point. Until the Shop Order is closed (completed), its location and progress are recorded in the disk files by means of "RDI" (Remote Data Input).

As the part being manufactured progresses through various operations, machine time and labor distribution are recorded through the remote data inputs as they occur. After a series of manufacturing operations, inspection points are reached, and inspectors also record inspection point results on the remote data input units.

Because current shop order information is available at all times, location of a part or Shop Order and determination of its status are simple and immediate. They are accomplished by interrogation of the disk file from any inquiry station. This is especially helpful in handling engineering changes which frequently occur after manufacturing is started. (Since some 40,000 shop orders are in process at any given moment, and each is progressing through a series of operations, locating a specific item or shop order before the ADA system became operational was very difficult and kept a large staff of expeditors and clerks busy full time.)

Inspection results from Manufacturing, and Receiving Inspection Reports from the Procurement area provide data used to prepare Manufacturing and Supplier Product Performance reports. These reports show the nature, frequency, and disposition of defects, and provide statistical analyses by Part Number, Crew Number, Supplier, Manufacturing Organization, etc.

Because production workers record their direct labor charges as they occur, data for labor distribution reports are available much sooner than in the pre-ADA systems. Programs include a daily edit of the labor data so that most errors may be caught and corrected within the reporting period.

Appropriate accounting entries, such as Purchase Order Commitments, Labor entries and Material Cost are abstracted as they are generated. These entries are accumulated on magnetic tape, and provide input to periodic accounting reports. Also, a Finance monitored master file reviews all work orders for authorization before procurement or manufacturing action takes place.

The entire MCS/ADA system is a complex linkage of programs. These programs generate many reports which were not feasible previously because of the difficulty of coordinating data or its unavailability. In addition, data appearing in previously existing reports which were incorporated in the MCS/ADA system (e.g., labor) are now in agreement wherever they appear, since the same data with the same cutoff are used throughout.



QUERYING ADA — A query on job progress by an operator of the ADA system at Lockheed is directed to the central computer where information from production workers is stored. ADA locates the answer and replies within seconds via high speed printers.



REPORTING TO ADA — Polaris fleet ballistic missile assembler reports job progress by using a punched card and a plastic identification badge. The report is transmitted by telephone line to the central computer system.

COMPUTAX PROGRAM WINS ACCOUNTANTS' ENTHUSIASM

A highly favorable response has been received from accountants throughout the country to CSC plans for the processing of 1964 federal and state tax returns by the COMPUTAX system.

At CSC's first COMPUTAX seminar for accountants this month, Neil Bersch, Tax Manager for the Los Angeles office of Touche, Ross, Bailey & Smart, announced that his office could use the CSC service for virtually all its returns during the coming tax season. Mr. Bersch also reported that the New York office of his company indicated that all of their returns would be suitable for the COMPUTAX service. Touche, Ross, Bailey & Smart is rated as one of the top ten national accounting firms.

Other national firms of comparable size have indicated their acceptance of the COMPUTAX service and are planning its use for 1964 returns.

COMPUTAX seminars are presently being held in New York City, Los Angeles, San Francisco and other major cities where the service will be offered. Franchise dealers have been appointed in Sacramento, San Francisco, San Diego, and Dallas.

In New York City, CSC will service accounts from its office at 660 Madison Avenue. Tax Manager for this office is Ronald Buren.

Marketing representatives for COMPUTAX include Mark Baum, Tim Dalsimer, Gordon Gary, Gene Johnson, Vince Lynch, Tom Mann, Ron Miller, Gene Schroeder, Mike Sherry, Allen Smith, and John Sodano.

PAUL APPOINTED TECHNICAL MANAGER OF COMMERCIAL APPLICATIONS

Robert Paul was appointed Technical Manager of the Commercial Applications Department at CSC.

Mr. Paul's responsibilities include technical direction of all projects in the commercial field.

A veteran of more than eight years in the information sciences, Mr. Paul joined CSC in June, 1959. At CSC, he was formerly a senior member of the technical staff and project manager for the development of various programming systems, including COBOL compilers for several machines.

Prior to joining CSC, Mr. Paul served with the Rocketdyne and Columbus divisions of North American Aviation in various programming capacities.



EG&G AWARDS \$100,000 CONTRACT TO CSC SERVICE BUREAU

Edgerton, Germeshausen & Grier, Las Vegas, Nevada, has awarded the CSC Service Bureau Division an additional \$100,000 contract for continuing use of the 1107 computer.

EG&G has been a client of the CSC Service Bureau since January, 1963, for problem solutions in the scientific field under contracts from various government agencies.

According to Dr. William Lorber, Scientific Specialist at EG&G, the selection of the CSC Service Bureau and its large scale 1107 computer is attributed to "a highly efficient programming system and the availability of large drum memory."

In computer comparison tests of run times, Dr. Lorber pointed out that a typical scientific problem was run in FORTRAN language on the CSC 1107 in 11 minutes as opposed to 13 minutes on the CDC 3600. In view of the fact that competitive computers such as the 3600 and IBM 7090/94 are more than twice as fast as the 1107 in memory speeds, the effects of exceptionally efficient programs for the 1107 are particularly notable, Dr. Lorber added.

The large drum memory at the CSC Service Bureau provides EG&G with more than 4½ million words of additional storage. This has also proved an important feature in the company's ability to obtain efficient problem solutions at CSC for complex scientific applications.

WASHINGTON DIVISION INCREASES STAFF

Both management and technical staffs at CSC's Washington Division were substantially increased this month as a result of new contracts received from government agencies, military and research facilities on the Eastern Seaboard.

An extensive recruiting drive is also under way in such cities as Boston, New York, Baltimore, and Washington for senior

programmers and analysts in both commercial and scientific fields.

Recent additions to the technical staff in Washington include: Weldon Dennis, Donald Jackson, Wallace Jungmeyer, Paul Kazek, James McPherson, Valmer Norrod, Pat Sexton, Bernard Thielen, Rand Tuttle, and Lou Webb.

Also assigned to the Washington Division are Fred Brand, Larry Felton, Thomas Fosnight, Jerry Kambestad, Alan Stewart, Raymond Wagstrom, and Vaughn Westaway.

At present, there are more than 150 man-years experience among the technical staff assigned to CSC's Washington Division.



The Jet Propulsion Laboratory's Space Flight Operations Facility (SFOF) is shown above. CSC specialists have implemented a complex computer programming system for real-time operations in various spacecraft missions. CSC has provided services to JPL since May, 1961.

PRICHARD JOINS CSC AS CONTRACTS ADMINISTRATOR

Donald L. Prichard was appointed Contracts Administrator at CSC last month.

Mr. Prichard was formerly with the Los Angeles Division of North American Aviation for over three years. His responsibilities included negotiation and administration of major government contracts.

Prior to that time, he was employed by the Central Intelligence Agency.

Mr. Prichard is a graduate of George Washington University, having received both a Baccalaureate in Accounting and a Law Degree.



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